

Supporting Information:
**Optimal Design of Sustainable Ammonia-Based
Food-Energy-Water Systems with Nitrogen
Management**

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System equipment capacity ranges

Table S1: Equipment capacity ranges. Data without reference are adopted from Palys et al.^{S1}

Process Unit	Capacity range	Fixed CC	Unit CC	Fixed OC	Unit OC
Wind turbine ^{S2}	12.5-125,000 kW	13,750	1,104	-	-
Solar arrays ^{S2}	7.32-365,876 kW	16,830	2,301	-	-
Electrolysis	1-15 kg H ₂	310,010	84,500	0.063	0.42
PSA	3.8-25 kg N ₂	16,400	2,550	0.025	0.10
Ammonia Sythesis	4.5-40 kg NH ₃	183,000	34,900	0.006	0.015
Urea Sythesis ^{S3}	2-83,333 kg urea	128,872	155	0.05	0.7708
Hydrogen Fuel Cell	1-1,000 kW	23,160	1,985	0.6	0.06
Ammonia Genset	0-1,000 kW	1,785	825	0.45	0.045
Biomass Genset	0-1,000 kW	7,260	3,360	0.9	0.09
Reverse Osmosis ^{S4}	0-900,000 GPD	8,300	46.5	1.8	0.0002
Battery	10-50,000 kW	827,500	660	3.6	0.00715
Biomass to Hydrogen	100 kg H ₂	-	215,120	1.68	1.68
Bioreactor ^{S5}	0-2,000 tonnes H ₂ O	-	140	-	- *
Hydrogen Storage	1,600 kg H ₂	-	800	-	-
Nitrogen Storage	22,400 kg N ₂	-	160	-	-
Ammonia Storage ^{S6}	30,000 kg NH ₃	-	6.85	-	-
Biomass storage	0- 195,210 kg	-	0.0165	-	-
Urea Storage ^{S7}	500-100,200 kg urea	-	0.2433	-	-
Water Storage ^{S8}	30,000,000 kg	-	0.5	-	-

CC: Capital cost

OC: Operating cost

*. Replacement cost every 5 years: \$19.469 per m^3

Capital and operating costs

Table S2: Capital and operating costs of selected designs

	min N loss	Trade-off	min NPC
Capital Cost			
ELC	150,306.9	150,832.5	150,876.7
PSA	5,107.244	5,111.08	5,316.472
ASY	67,350.17	67,403.83	70,277.06
HFC	166,991.7	166,775	167,256.3
AGS	19,046.07	18,861.1	18,795.12
REO	394,616.6	7,335.372	2,223.438
WTB	299,596.5	299,596.5	299,596.5
PVA	99,155.33	97,819.13	98,798.56
USY	11,396.09	11,396.09	0
BR1	24,679.78	20,111.15	0
BR2	24,679.78	33.80931	18.67713
HYG	61,419.24	61,576.19	61,205.74
H2O	9,187.511	9,139.661	9,408.762
NIT	1,280.609	1,281.951	1,353.807
NH3	30,353.43	30,354.4	29,883.17
UREA	18.38121	29.24035	0
Operating Cost			
ELC	25,272.69	25,166.67	25,734.21
PSA	10,733.01	10,742.82	11,344.98
ASY	1,954.942	1,956.728	2,066.407
HFC	42,742.61	42,433.49	42,424.34
AGS	4,311.51	4,270.546	4,463.377
REO	14,652.28	1,012.303	365.0582
WTB	0	0	0
PVA	0	0	0
USY	1,610.653	2,527.641	0
BR1	38,938	31,729.94	0
BR2	38,938	53.34192	29.46744

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